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Pedagogical use of ELICIT for Leadership Training: Survey and Recommendations

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14. ABSTRACT Development of and experimentation with ELICIT (The Experimental Laboratory for Investigating Collaboration, Information-sharing and Trust) is an ongoing activity of the U.S. DoD Command and Control Research Program (CCRP) within the Office of the Assistant Secretary of Defense for Networks and Information Integration (OASD/NII). ELICIT has been used not only for research experimentation, but also in conjunction with classroom training as part of leadership development programs. ELICIT is particularly helpful in teaching the strengths and weakness of various organizational structures (edge organization vs. traditional command and control hierarchy.) This paper reviews some of the pedagogical uses of the classroom training to date, and provides recommendations for the use of ELICIT in various classroom settings.				
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ABSTRACT

Development of and experimentation with ELICIT (The Experimental Laboratory for Investigating Collaboration, Information-sharing and Trust) is an ongoing activity of the U.S. DoD Command and Control Research Program (CCRP) within the Office of the Assistant Secretary of Defense for Networks and Information Integration (OASD/NII). ELICIT has been used not only for research experimentation, but also in conjunction with classroom training as part of leadership development programs. ELICIT is particularly helpful in teaching the strengths and weakness of various organizational structures (edge organization vs. traditional command and control hierarchy.) This paper reviews some of the pedagogical uses of the classroom training to date, and provides recommendations for the use of ELICIT in various classroom settings.

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Overview

ELICIT, the Experimental Platform for Investigating Collaboration, Information-sharing and Trust was originally developed as a platform for conducting formal experiments on the effects of using edge vs. traditional hierarchy organization structures. Over time it became clear that restricting the organizational modes to the traditional hierarchy and edge structures did not allow for the exploration of hybrid structures, so the ELICIT software platform was enhanced to support flexible structures and additional forms of communication. The post experiment discussions at research universities evolved into the use of ELICIT as a classroom tool.

Though ELICIT has been used at both civilian and military educational institutions around the world, the most significant pedagogical use has been in military schools, so most of the examples in this paper are from military training. Based on the author's experience with civilian leadership training, it is the author's belief that the results apply to both military and civilian management training.

This paper describes the evolution of ELICIT as a pedagogical tool and provides guidance to institutions considering ELICIT for classroom use. The target audience is persons who are considering creating a course on agile leadership or just using ELICIT as a one session augmentation to an existing leadership program.

This paper is based on my personal experiences using ELICIT with students, working with researchers and educators to adopt ELICIT for use in their classrooms, and follow-up interviews. The paper provides a framework for viewing the evolution of ELICIT as a pedagogical tool, what has been done and what works.

Original Intent of ELICIT Platform

ELICIT was developed by the United States Department of Defense Command and Control Research Program (CCRP) of the Office of the Assistant Secretary of Defense for Networks and Information Integration (OASD/NII) as part of their initiative to develop and test principles of organization that enable transformation from traditional hierarchy-based command and control practices to more agile practices that transfer more power and decision rights to the edge of the organization. The need for agility in Information Age militaries is becoming increasingly important. As discussed by Alberts and Hayes in *Understanding Command and Control*, in an era of complex, coalition, civil-military operations, understanding how to organize for agility not just within a specific organization but also across differing organizations and cultures is a key success factor.

There had been a shortage of formal experimentation data on the efficacy of different Command and Control (C2) organizational approaches. In order to remedy this shortage, the CCRP created and continues to sponsor and maintain the ELICIT research environment. ELICIT is a Java-based software platform that can be used to run multi-user experiments focused on information, cognitive, and social domain phenomena. People participate in research sessions mediated by ELICIT by working together in teams that can be configured to reflect different organizational approaches (e.g., hierarchy, edge, hybrid and others) and that can be subjected to a wide variety of configurable conditions.

The ELICIT platform supports configurable scenarios that focus on the task of identifying the “who”, “what”, “where”, and “when” of a fictional adversary threat. Information in the form of “factoids” is provided periodically to each of the participants during an experiment session. The factoids and their distribution are structured so that no one participant receives all the information necessary to perform the task; thus, information sharing is required in order for any participant to be able to determine a solution to the ELICIT problem.

ELICIT provides an instrumented task environment that captures and time stamps participants' information sharing activities. The environment generates detailed transaction logs summarizing this information. These, together with participant surveys that can be administered either prior to a trial (for calibration), after a trial, or in situ, can be used to measure information sharing, collaboration behaviors and situational awareness, as well as a variety of value metrics including the ability of individuals and teams to correctly identify the future adversary attack and the time required to do so. A log analyzer can be used to quickly analyze the logged data so that the results are available immediately for classroom discussion.

ELICIT supports both student participants and also software agent participants. The software agents can be used in conjunction with students so that the ELICIT can be played regardless of the number of students registered for a particular course (with the agents filling in for any missing students needed to complete a particular organization structure.) These software agents are semi-intelligent agents with a sensemaking capability. Based on data they receive, the agents construct a “mental model” of the threat scenario and thus use “situational awareness” to determine their actions. The agents have ~50 configurable variables to define their personalities and styles of social interaction with the other experiment participants. Using these variables, agents can be configured to operate in human timeframes (e.g., seconds and minutes), rather than just computer timeframes (e.g., nanoseconds and microseconds), show human levels of variability and human personality traits such as tendencies to hoard information, reciprocate favors and trust team members (among others).

Considerable research has been conducted to date using ELICIT. A selection is included in the bibliography. The ELICIT platform continues to evolve to meet the ongoing needs of researchers and educators. Though ELICIT was originally conceived as a research tool, often the exercise debriefings evolved into energetic classroom discussions, particularly when a suitably

experienced leader was present to lead the conversation. Since most of the ELICIT research relies on military and business students as participants, overtime it was realized that ELICIT could also be leveraged for use as a pedagogical tool in the classroom.

Role of Computer Simulations in the Classroom

There is a long history of using computer games and simulations for training and as part of formal degree programs. Often the dynamics of real-time complex systems such as distributed team management are counter-intuitive. Simulations in which students personally experience the dynamics of successive rounds of interaction can be very effective at teaching lessons in network operations. Simulations and games can also provide a useful counterpoint to “death by PowerPoint.” Thus business schools have for some time used simulation games to augment classroom lectures. For example, the School of Management at Massachusetts Institute of Technology (MIT) has long used the Beer (distribution) Game to teach a number of key principles of supply chain management. Participating in an exercise in which your leadership decisions impact your game score, under circumstances where you can compare your performance to other members of your class, creates a strong visceral experience for student leaders. Students better understand the dynamics and implications of their choices because they have personally experienced them.

ELICIT Use in the Classroom

The ELICIT platform is flexible enough that it can be used in a variety of educational formats. It has been used as part of an afternoon session, as part of a one day course and integrated into a semester course as part of a multiple class experience. The original baseline ELICIT experiment protocol consisted of the following:

- Introduction
- Pre-briefing video
- Opportunity to read written instructions
- Practice round (20 minutes)
- Break
- Actual round (60 minutes)
- Post experiment survey
- Post-briefing video
- Optional discussion session

The first eight steps typically take two to two and a half hours to conduct. For use in the classroom, this eight step sequence was modified to fit into a typical one hour class period by removing the break and the practice round; and shortening the introduction, survey and actual round to 40 minutes (note there was generally not much activity in the last twenty minutes of a 60 minute round anyway.) It was found that making these changes did not change the fundamental results and made it much easier to schedule students as participants. For courses with longer classroom sessions, these modifications left more time for preparatory lecture and meaningful discussion.

The first few times ELICIT was used at a university (Boston University), the post experiment debriefing (with civilian business students) was extended into a discussion period so that the experiment designers and ELICIT platform developer could get general feedback. These discussions were lively and spirited and it was observed that there was potential for using ELICIT as a training tool, not just a research tool.

The first time that the post experiment discussion session morphed into a classroom experience in its own right (rather than merely a debriefing on the experiment itself and how the experiment could be improved) was when the baseline ELICIT experiment was run at West Point. The experiment was run with a group of first year cadets (half in an edge organization and half in a traditional hierarchy.) When the exercise was completed, a Colonel led an energetic discussion on the subject of intelligence gathering and how one determines if one has identified a threat with sufficient certainty that it is appropriate to recommend its destruction. He took an exercise in how organizational structure impacts task effectiveness, and explored not only the pros and cons of organizational structure, but discussed the effect of training on structure effectiveness, what types of behaviors they considered constructive or destructive in team members and how one makes decisions.

Part of what made this discussion interesting, was that the cadets had just had the personal experience of trying to identify the advisory attack in an ELICIT scenario under time pressure, with limited information and the knowledge that their competitive classmates were also performing the same task (note student participants are anonymized to protect their privacy.) Cadets were able to discuss their own experience of working in the traditional hierarchy or distributed edge organization and explore their theories for why one worked better than the other in this particular scenario. They were also able to compare and contrast what it felt like to operate under the two organization structures.

It was from this session, that the ELICIT Community of Interest (COI) first began to believe that in addition to using ELICIT as a platform for conducting formal research, ELICIT could also be valuable as a formal instructional aid.

The first time that ELICIT was used to facilitate a training discussion was at the Portuguese Military Academy in July 2006. At that time, ELICIT required the installation of client software

and the automated capabilities for analyzing the log files were in a development stage, so preparing a lab for an ELICIT exercise was fairly labor intensive and only a very basic analysis of participant performance was available immediately after an exercise. This limited the scope of post exercise discussion. An ELICIT expert was brought in to facilitate the discussions.

The first time the hosted version of ELICIT was used a part of a formal class was in a one day session on distributed leadership for mid career officers with high potential held at the Naval War College in January 2008.

This class consisted of about 32 students. After a discussion on leadership and organization, the class was divided into two groups: one operating in a traditional hierarchy and the other in an edge organization. Since the classic ELICIT scenarios require 17 participants each and the class size was a little less than 34, the two groups were augmented by a couple of software agents so that there were 17 participants (mostly human) in each group. The software agents were configured to be supportive participants that passed on all the information they received. In summary, the organization of the one day session was as follows:

- Discussion
- ELICIT trial (half the students participating in edge and half in a traditional hierarchy organizations)
- Lunch break (during which the log files for the two groups were analyzed and turned into a power point presentation that compared and contrasted the performance of the two groups in the classroom and the behavior of previous research participants.)
- Presentation of the results followed by a student and leader discussion.

Examples of the discussion slides are available from the ELICIT COI. Some of the elements of the day that made it effective and practical included the following:

- The software was available at no charge from the CCRP so that procurement issues were not an impediment
- The ELICIT software was available over the Internet so the school only need to supply internet connections
- The class was large enough to support running ELICIT with two groups that had different organizational structures so there were a variety of experiences in the classroom on which to base discussion
- The class was big enough to include a variety of perspectives, and small enough so that most could participate in the discussion
- Discussion leaders in the room included senior naval officers and a retired admiral as well as Dr. Richard Hayes and Dr. David Alberts, authors of *Power to the Edge* so that there was lively, informed discussion backed by real world leadership expertise
- A detailed analysis of the performance of the two groups was available for the discussion so that questions could be answered and theories on causes of performance variations addressed

- Results for previous research runs were also made available to address competitive curiosity and show that the results they experienced were not happenstance but also reproducible experimentally.

The most integrated use of ELICIT in a course to date is in the Netcentric Warfare and Operations (NCW) elective course, at National Defense University (NDU). The course, developed by Dr. Cathryn Downes, Professor, Information Strategies Department, “examines the tenets and technologies of network centric warfare and operations (NCW) as an evolving way of warfare and a central component of Department of Defense (DoD) innovation for future operations. The nature and dynamics of information-enabled networks are examined, as are other emergent technologies that are influencing how NCW evolves.” It is a full 24 hour credit course consisting of 12 two hour sessions.

This course has been offered twice as of the writing of this paper, and its use of ELICIT has evolved both in terms of the ELICIT software used and the software’s use in the course. The course’s students are typically mid career officers from the United States and coalition partners. In its most recent offering, the students were mostly O5 and O6 level chiefs of staff. ELICIT is used to provide a “mini command problem” that augments the logic of the classroom lesson with real experience. Its use in the course is timed to provide an “ah ha” to the class. One student, after taking the course reported that he spent a whole year in Iraq doing nothing but “feeding” his commander, and that he now understood that he should have been finding out what everyone else needed. One student had previously thought that he would never be promoted past the Brigadier General level, and now sees how he could command at even higher levels. Professor Downes reports that “ELICIT prompted them [the students] to think about the costs and consequences of hierarchy vs. networked organizations.” NDU’s Netcentric Warfare and Operations (NCW) class won an award the first time it was run.

NDU Methodology

In its current formulation, ELICIT is used three times during the course in successive classroom sessions. In the first session, ELICIT is run in a hierarchy configuration to show the students a baseline. The second use is with an edge (or distributed) organization. This provides the students a sharp contrast to the experience with the traditional hierarchy configuration. After the second usage, and discussion of the strengths, weakness and issues of organization structure, students are invited to spend ten minutes suggesting what they consider to be an ideal hybrid organization. Then before the next class, the new organization structure is configured, and the students have the opportunity to see how their proposed hybrid structure works and experience what it is like to operate under it. The students are then led in a classroom discussion of how the new org structure met or did not meet their expectations.

In the most recent class, the hybrid design was implemented using the ELICIT organization configuration file and the use of a new feature called progress check. Progress check allows participants to share their current theory about the adversary attack with other participants and for participants to see the other player's latest theories. This is somewhat similar to the post card approach used by Leweling in her ELICIT research in which participants were able to share a post card containing their best theory about the adversary attack with another participant. (i.e. very controlled disclosure of theories.) For their hybrid design, the students also chose to use the structured format for their Identifies (identification of the adversary) and to enable Tweet sized free form text messages. The ELICIT features they chose are relatively recent enhancements. ELICIT now supports a much wider variety of communications forms than used in the original experiment.

Note that since it was a multi-national class, some participants had better English skills than others so it was necessary to ensure that the person in the Cross-team Coordinator role in the hierarchy had good English skills.

The most effective use of ELICIT is as a counterpoint to pre-conceptions. Thus running ELICIT in two organizational modes, so the students can compare and contrast them, is a core part of using ELICIT in the classroom. This effect is so dramatic that the third round may not be necessary. On the other hand, now that ELICIT offers a much richer set of organizational structure options and communications methods, it is possible to use ELICIT to practice designing task specific communications networks and evaluating their efficiency. Thus, NDU is considering using ELICIT for a fourth round so that students can further practice this new skill.

Key Success Factors

- **Structuring the class to provide experiences in both edge and traditional command and control hierarchy organizational structures.** The core use is to provide the students the opportunity to experience both edge and hierarchy organization structures so that students can compare and contrast structures for task effectiveness. This means structuring the course so that either multiple teams use the different structures simultaneously or that each student has the opportunity to sequentially experience operating under varying organizational structures.
- **Integrating ELICIT into the course.** Giving careful consideration to how ELICIT fits into your over all curriculum and educational objectives. What is the ideal place(s) in the course to use ELICIT to augment the education experience? What is the motivation for its use? Which of the many lessons do you wish to highlight?

- **Having a strong, credible discussion leader.** For military students, the credible discussion leader is a dynamic leader with recent combat experience (i.e. “street cred”.) In addition, for a class with military personal, the discussion leader needs to have sufficient rank when compared to the students. For the NDU course that means a Colonel or above with recent deployment in a war zone. (NDU was fortunate enough have the honor of having a General join them for one class.) Even for cadet level participants at the Military Academy, a Colonel can be a very effective addition. It is possible that Colonel is the minimum rank for leading this type of discussion at a military academy. The Naval War College session was augmented with a retired Admiral. It would be interesting to get more data points on this issue. The higher the rank of the discussion leader, the more the ELICIT exercise can be used as a jumping off point for a high level general leadership discussion.
- **Arranging for technical support.** This includes someone to configure the class exercise(s) in ELICIT and to analyze and interpret the log files during the class. It is important for the learning experience that the students see the results of their performance under the various organizational structures while the experience of participating in the process is still fresh.
- **Arranging to use scenarios that are relevant and realistic for the class.** All classroom scenarios are by definition abstracted from reality. It is important that the selected scenario be one to which the students relate. The ELICIT intelligence task is well suited to a variety of military and civilian leadership students; however the core scenarios won’t be suitable for all students. The existing scenarios have only true information, so the scenarios don’t yet support discussion of counter intelligence tactics.
- **Arranging for appropriate class sizes.** Though agents can be used to substitute for human participants in the classic ELICIT hierarchy scenario, due to the nature of the organization structure, nine is really the minimum number of students that makes sense, and it is better to have at least 13.

Lessons Illustrated by ELICIT

There are a number of lessons that can be illustrated with ELICIT. As with all teaching, the most effective training starts with the experience base of the class, is adapted to the education objectives, and takes into account the range of experience in the group. Because ELICIT is a configurable platform, it can be used for management and leadership training at a variety of levels. To date, ELICIT training has been used with college freshman all the way to mid career military officers. Participants have included PHD students, professors and Special Forces. (Using professors as participants in ELICIT is not recommended. Yes, we learned this the hard way.) It

has been used with persons who were trained to use traditional hierarchy organizations as the first choice for organizational structure as well as persons who had no formal training in operating as part of a hierarchy and are accustomed to operating in distributed organizations. It has been used with civilian and military academies in the US and abroad. See Appendix A for a partial list of participating schools.

The core ELICIT lesson is that some tasks are more efficiently and effectively performed by teams with a distributed organizational structure rather than a traditional hierarchy. Since ELICIT has been used to conduct formal experiments, it has been used to explore other conditions that impact organizational agility and there are additional auxiliary lessons. These include that:

- The organizational structure (network structure) you use matters. You shouldn't assume that the organizational structure you are given (or start with) is the right one for every task (Cranfield University.)
- The power of distributed leadership is valuable especially in solving complex and network problems.
- More bandwidth doesn't always make it easier to do the task. This is frequently asserted, but the addition of unrestricted chat communications (Singapore Armed Forces Centre for Military Experimentation) has been shown to reduce the effectiveness of ELICIT teams. (Note that historically the military has used various practices to manage communications on various official channels to reduce the possibility of communications overload.)
- Situation conditions and training impact the optimal choice of organization structure (NPS and Portuguese Military Academy.)
- Many, though not all, of the tasks performed by today's military, military analyst or knowledge worker are better performed in edge rather than traditional command and control hierarchy organizational structures.
- The starting level of group trust influences the effectiveness of an organizational structure (NPS.)

ELICIT has been used at wide range of experience levels. One can hold leadership conversations with students at multiple levels depending on student and instructor experience. The results produced by ELICIT are dramatic and reproducible in the classroom. As ELICIT research progresses and evolves, there will be additional lessons from ELICIT research that can be brought into the classroom.

Example Discussion Leader Topics

- How will more connectivity impact task performance? Is the answer different for timeliness and accuracy?
- In what situations are edge organizations more appropriate and in which situations are traditional command and control hierarchies more effective?

- How does previous training influence ability to perform under different organizational structures?
- Should team trust influence the organization structure chosen? If so how?
- How well do you trust the answers you determined during the exercise?
- Did anyone in your group hoard information? If so, why? What was the effect? (The phenomenon of “hoarding” information occurs in many ELICIT exercises and its discussion reminds students that in the real world, directives don’t always lead to the results expected.)
- Did anyone in your group spam the group? If so why? What was the effect?
- What types of team member behavior are not effective in particular organization structures?
- How should an ideal team member behave in particular organizational structures?

Next Steps

ELICIT has evolved significantly as a research and a pedagogical tool and continues to mature. One possible further extension is to support personalized training. Each student could access their own virtual version of ELICIT with 16 software agents configured to be supportive or not supportive of the mission, etc. in accordance with the goals of the training. Then each student could experience exactly the same conditions as all the other students. While it is possible to influence student behavior by varying the instructions to the students, adult students don’t always follow instructions, so this would provide much more controlled learning experiences. This approach would also support training of more variable sized groups, and a wider variety of experiences.

Additional suggestions that have been made by classroom leaders include:

- Making the participant user interface more aesthetic. (The original interface is sparse and functional to eliminate unintended variables. It could be made more appealing).
- Adding additional and more realistic scenarios, especially those that include conflicting information.
- Enhancing the ELICIT agents so that they are also able to perform the newer communications functions.
- Continuing the interaction of ELICIT researchers and ELICIT educators to bring additional ELICIT lessons to the classroom.
- Using ELICIT to teach students the new skill of how to optimize the organizational approach for the task and situation.

One of the purposes of ELICIT is to perform formal research in the area of agility and to advocate for the appropriate use of varying organization approaches. Therefore CCRP has used a distributed approach to organizing the ELICIT Community of Interest and has been very supportive of innovative uses of ELICIT. Suggestions for further evolution of ELICIT and its uses are strongly encouraged.

Conclusions & Discussion

Though military leaders have been writing about the art of leadership since Sun Tsu, network science and agile leadership are relatively new fields of study. Often students, even or especially ones with years of command experience, come to class with preconceived notions about how best to organize their teams. Use of ELICIT-based leadership exercises in the classroom can be a useful way to help students viscerally internalize lessons about the effects of organization structure on team effectiveness. ELICIT helps students appreciate the effects of varying organizational structure.

ELICIT has evolved from being just a research tool to also being a pedagogical tool. ELICIT was conceived as a platform that would increase research leverage because it could be reused by multiple researchers. Since the same tool has been optimized for use in both in the research lab and the classroom, ELICIT can be used both as a research tool and as a tool for bringing these new research results to life in the classroom in a seamless fashion. The same configurable features that allow ELICIT to be used to conduct a wide variety of experiments can also be used to enable students to explore approaches they believe could improve their leadership effectiveness.

Bibliography

Alberts, D.S. and Hayes, R.E., *Power to the Edge* Washington, DC: CCRP (2003).

Alberts, D.S. and Hayes, R.E., *Understanding Command and Control*, Washington, DC: CCRP (2006).

Alston, A., "Assessing the Difficulty and Complexity of ELICIT Factoid Sets", *Proceedings International Command & Control Research Symposium*. Santa Monica, CA (2010).

Anderson, C., McEver, J.G., Wynn, D., and Ruddy, M.E., "Exploring the Effects of Individual Characteristics on Organizational Performance using the ELICIT Experimentation Platform", *Proceedings International Command & Control Research & Technology Symposium*, Washington, DC (June 2009).

CCRP, Command & Control Research Program ELICIT COI Workshop, Vienna, VA (2007).

CCRP, Command & Control Research Program ELICIT COI Workshop, Vienna, VA (2009).

Chan, K., Ivanic, N., "Connections between Communications and Social Networks Using ELICIT", *Proceedings International Command & Control Research Symposium*. Santa Monica, CA (2010).

Downs, C., Netcentric Warfare and Operations (NCW) course description, NDU (2009) http://www.ndu.edu/icollege/interactive_schedule/course_descriptions/ncw-details.html.

Drucker, P, *The Effective Executive* (1967).

Fredette C. and M.J. Waller (2010), "The Development of Team Coordination: An Investigation Using the ELICIT Simulation and THEME Pattern Recognition Analysis". *25th Annual Conference of the Society for Industrial and Organizational Psychology*, Atlanta, Georgia. (2010).

Fredette C. and Branzei, O. "A Practice-based View of Capability Discovery in Group Settings" Submitted to the Fourth International Conference on Organizational Routines, (2010).

Freidman, A., Bernstein, E. and Lazer, D., "Organizational Structure, Exploration, and Exploitation on the ELICIT Experimental Platform", *Proceedings International Command & Control Research Symposium*, Santa Monica, CA (2010).

Kalbfleisch, L. and Nissen, M.E., "Extending Hypothesis Testing of Edge Organizations Using Functional Magnetic Resonance Imaging During ELICIT," *Proceedings International Command & Control Research & Technology Symposium*, Santa Monica, CA (June 2010).

Li, M. and Simchi-Levi, D., The Beer Game, <http://beergame.mit.edu/guide.htm>, MIT, (2002).

Leweling, T.A. and Nissen, M.E., "Hypothesis Testing of Edge Organizations: Laboratory Experimentation Using the ELICIT Multiplayer Intelligence Game," *Proceedings International Command & Control Research & Technology Symposium*, Newport, RI, (June 2007).

Lospinoso, J. and Moxley, F., "The ELICIT Experiment: Eliciting Organizational Effectiveness and Efficiency under Shared Belief", USMA, www.netscience.usma.edu/publications/Elicit.pdf

Mancik, E. and McCaskill, J., *ELICIT: Tracking Networks*, Assembly (May/June 2007) West Point, pp. 30-31.

Ng, E.C., Thunholm, P., Cheah, M., Tan, K.Y. and Chua, N., "Exploring Alternative Edge versus Hierarchy C2 Organizations Using the ELICIT Platform with Configurable Chat System", *Proceedings International Command & Control Research Symposium. Bellevue, WA* (June 2008).

Nissen, M.E., "Exploring Edge C2 Approaches: ELICIT and POW-ER Tools," *Plenary Presentation, International Command and Control Research and Technology Symposium*, Newport, RI (June 2007).

Nissen, M.E., "Hypothesis Testing of Edge Organizations: Specifying Computational C2 Models for Experimentation," *Proceedings International Command & Control Research Symposium*. McLean, VA (2005).

Nissen, M.E. and Buettner, R.R., "Computational Experimentation with the Virtual Design Team: Bridging the Chasm between Laboratory and Field Research in C2," *Proceedings Command and Control Research and Technology Symposium*, San Diego, CA (June 2004).

Powley, E. H., and Nissen, M.E. and Seykora, J, "Study of Trust as an Organizational Contingency, Part II: Examining Four Dimensions of Trust in ELICIT Experimentation," *Proceedings International Command & Control Research & Technology Symposium*, Santa Monica, CA (June 2010).

Powley, E. H., Nissen, M.E., "Trust-Mistrust as a Design Contingency: Laboratory Experimentation in a Counterterrorism Context," *Proceedings International Command & Control Research & Technology Symposium*, Washington, DC (June 2009); recommended for Best Paper Award.

Rosinha, A. and Esteves, J., "Emergent Leadership on Edge Organizations: Building Trust and Cooperation in the Context of ELICIT Experiments", *Proceedings International Command & Control Research & Technology Symposium*, Santa Monica, CA (June 2010).

Ruddy, M.E., *ELICIT 2.4 Software Guide*, Parity Communications Inc., Arlington, MA (2010).

Ruddy, M.E., *Phase 2 - Final Detailed Design for Agent-based Processing v1.1*, Parity Communications Inc. under contract to Evidence Based Research, Chestnut Hill, MA (2007).

Ruddy, M.E., Wynn, D., and McEver, J., “Instantiation of a Sensemaking Agent for Use with ELICIT”, *Proceedings International Command & Control Research & Technology Symposium*, Washington, DC (June 2009).

Ruddy, M.E., and Nissen, M.E., “New Software Platform Capabilities and Experimentation Campaign for ELICIT”, Parity Communications, Inc. Under contract to the Naval Post Graduate School Center for Edge Power, Arlington, MA (2008).

Stanton, N., Sorensen, L. and Walker, G., “Phase Space Shifts in Command Structures in Networked Systems”, *Proceedings International Command & Control Research & Technology Symposium*, Santa Monica, CA (June 2010).

Tsu, S., *The Art of War*.

Wynn, D., Ruddy, M.E. and Nissen, M.E., “Command & Control in Virtual Environments: Tailoring Software Agents to Emulate Specific People,” *Proceedings International Command & Control Research & Technology Symposium*, Santa Monica, CA (June 2010).

Appendix A – Educational Institutions that have Used ELICIT

The CCRP is grateful for the participation of the following institutions and to those individuals who provided contact information for this paper:

Civilian

- Boston University
- Harvard University
- Loyalist College, Canada
- University of South Hampton, UK
- York University, Canada, contact Chris Fredette, [chris_fredette \[at\] carlton.ca](mailto:chris_fredette [at] carlton.ca)

Military

- Army Research Labs (ARL), contact Kevin Chan, [kevin.s.chan \[at\] us.army.mil](mailto:kevin.s.chan [at] us.army.mil)
- Cranfield University
- Defense Academy of the United Kingdom
- George Mason University
- Johns Hopkins University
- Military Polytechnic Academy, Army of Chile
- National Defense University, contact Cathryn Downes, [downesc \[at\] ndu.edu](mailto:downesc [at] ndu.edu)
- Naval Post Graduate School, contact Mark Nissen, [mnissen \[at\] nps.edu](mailto:mnissen [at] nps.edu), <http://www.nps.edu/Academics/Centers/CEP/>
- Naval War College
- Portuguese Military Academy, contact Marco Manso, [marco.manso \[at\] weare-company.com](mailto:marco.manso [at] weare-company.com)
- Singapore Armed Forces Centre For Military Experimentation, contact Mervyn Cheah, [mervyncheah \[at\] yahoo.com.sg](mailto:mervyncheah [at] yahoo.com.sg)
- US Army War College, contact Cathryn Downes, [downesc \[at\] ndu.edu](mailto:downesc [at] ndu.edu)
- US Military Academy
- Defense Research and Development Canada, Toronto, contact Matthew Duncan, [matthew_duncan \[at\] drdc-rrdc.gc.ca](mailto:matthew_duncan [at] drdc-rrdc.gc.ca)

Appendix B – Running ELICIT in a Classroom Environment

This appendix provides pointers on some practical details for using ELICIT in the classroom as a pedagogical tool.

Your Infrastructure

The minimum requirement is a classroom with internet access for each participant. Labs where a computer is provided for each student are ideal, but most students in most settings can bring a laptop if necessary. If Wi-Fi connections are used, care should be taken to ensure that bandwidth is sufficient. In some classrooms, additional routers have been necessary. There should also be a monitor or projector for displaying video and slides.

ELICIT Software

The ELICIT software and the survey software are available as hosted services on the Internet. There is no charge to members of the ELICIT COI for using the Software. Information about joining the COI is available at <http://www.dodccrp.org/html4/elicit.html>. The primary requirement for joining the COI is to provide copies of the raw data, analyses, learnings, etc. to the COI so that the community can leverage the experiences of its community.

For locations that block internet access, it is possible to install ELICIT and the survey server on a local intranet. ELICIT supports and has been tested with the Internet Explorer and Firefox browsers.

The ELICIT software comes with documentation and supporting materials for use in formal experiments and classroom exercises. These materials include:

- Pre and post briefing videos
- Welcome and order of proceedings slides
- Checklists
- Standard scenario configurations
- Log analyzer
- Sample analysis briefing

The ELICIT platform and its supporting materials should be considered a tool kit to add richness to a course rather than a course in and of itself. Contact the author for suggestions on adopting ELICIT to your specific circumstances.

Participants

The classic ELICIT hierarchy has 17 roles. So classroom exercises that include the classic scenarios require multiples of 17 students. As discussed it is possible to substitute software

agents for some of the students. Groups have been run with as few as 9 human participants and 8 agents.

It is technically possible to run ELICIT with 1 human and hundreds of agents), but we have not yet been using ELICIT this way in a classroom setting. In the future it would be possible to provide individual students fully controlled ELICIT experiences by having all of the other participants be agents that have been configured with specific personalities.

Timing

The Boston University experiment runs (first school runs) were conducted with 20-minute practice rounds and a 60-minute experiment round. A full hour is too long for most subjects. We recommend reducing the experiment round to 40 minutes. Subjects can become noticeably restless starting about 30 minutes into the experiment runs.

Twenty minutes is enough time for everyone to complete the classic survey.

Boredom

With the advent of smart phones and iPads, etc. it is regrettably helpful to instruct participants to not use other devices during an exercise.

Frequently Asked Questions

By software version 1.13 the user interface was so improved that questions about functionality virtually stopped. The moderator/coordinator checklist has been successively annotated to anticipate most of the other questions. The result is that we now have very few questions during the session after the instructions have been presented.

Staffing

With current software and processes, two people are sufficient to run a live ELICIT exercise. (Instructor and ELICIT operator.) You may want additional persons in the room to achieve specific discussion objectives.

The most successful ELICIT military classroom discussions have included senior officers (Colonel or above) as guests. A senior officer with command and field experience brings the needed credibility to discussions of military decision making.

Areas for Improvement

As with all exercises, especially those evolved from controlled experiments, there is always a dynamic tension between controlling for outside influences (variables) and realism (reality is messy.) The ELICIT scenarios currently used in the classroom don't include any conflicting information. This is an area we hope to address in the future.

Pedagogical use of ELICIT

ICCRTS 16

22 June 2011

Mary Ruddy

Sponsored by Evidence Based Research

Agenda

- Overview and original intent of ELICIT
- Evolution of classroom use
- Key success factors
- Lessons illustrated
- Sample discussion topics
- Where used
- How to get involved

ELICIT Introduction

- ELICIT-Experimental Laboratory for Investigating Collaboration, Information-sharing and Trust
 - Part of the Command and Control Research Program (CCRP)'s network-centric warfare initiative
 - Engaged in developing and testing principles of organization that transfer power and decision rights to the edge of the organization
 - Needed to frame testable hypotheses about the relative effectiveness of edge organizations in comparison to other methods of organization through a series of real-world simulations
 - Facility was created to run these experiments

Base Experiment

- Hypothesis testing experiment
- Live subjects, multi-user
- Run in edge or traditional hierarchy mode
- Experiment software records all actions for analysis

Experiment Task

- Identify the who, what, where and when of an adversary attack
- Task scenarios are anonymized
- Participants are anonymized
- Participants periodically receive factoids about the situation
- No one person has all the information needed
- Task success requires communication

ELICIT Evolution

- More flexibility in organization structure
- More flexibility in communications options
- More flexibility in task scenario
- Humans and software agents
- Use as a training tool

Evolution of Classroom Use



Research feedback

- Ad hoc
- No leader or agenda
- Not part of formal course
- Single point of experience
- Undergraduates

Evolution of Classroom Use



Opportunity for lesson

- Part of cadet education,
but not formal class
- Discussion leader
- Multiple points of
experience

Evolution of Classroom Use



Classroom session

- Guest discussion leaders
- Extended planned discussion
- Multiple points of experience

Evolution of Classroom Use



- Day long special topic
- Multiple guest discussion leaders
- Pre and post discussions
- Multiple points of experience
- Detailed analysis feedback

Evolution of Classroom Use

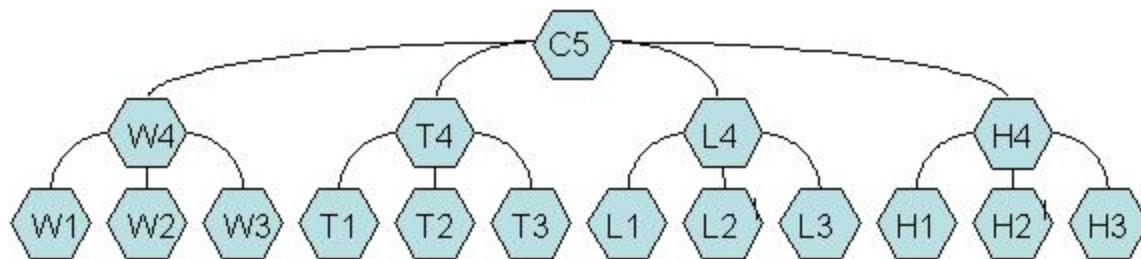


Part of multi-session course

- Integrated with lesson plan
- Guest discussion leader
- Multiple points of experience
- Detailed analysis feedback
- Multiple iterations for deeper insights
- Award winning course

Key Success Factors

- Live comparison - structuring the class to provide experiences in both edge and traditional command and control hierarchy organizational structures



Key Success Factors (cont.)

- Integrating ELICIT into the educational program
- Having a strong, credible discussion leader
- Arranging for technical support
- Arranging to use scenarios that are relevant and realistic for the class.
- Arranging for appropriate class size

Lessons Demonstrated

- The organizational structure (network structure) you use matters
 - Don't assume the organization. structure you start with is the right one for every task
(Cranfield University)
- The power of distributed leadership is valuable especially in solving complex and network problems
- The starting level of group trust influences the effectiveness of an organizational structure (NPS)

Lessons Demonstrated (cont.)

- More bandwidth doesn't always make it easier to do the task. (Singapore Armed Forces Centre for Military Experimentation)
- Situation conditions and training impact the optimal choice of organization structure (NPS and Portuguese Military Academy)
- Many, though not all, of the tasks performed by today's military, military analyst or knowledge worker are better performed in edge rather than traditional command and control hierarchy organizational structures

Sample Discussion Topics Include

- How will more connectivity impact task performance? Is the answer different for timeliness and accuracy?
- In what situations are edge organizations more appropriate and in which situations are traditional command and control hierarchies more effective?
- How does previous training influence ability to perform under different organizational structures?
- Should team trust influence the organization structure chosen? If so how?

Sample Discussion Topics (cont.)

- How well do you trust the answers you determined during the exercise?
- Did anyone in your group hoard information? If so, why? What was the effect?
- Did anyone in your group spam the group? If so why? What was the effect?
- What types of team member behavior are not effective in particular organization structures?
- How should an ideal team member behave in particular organizational structures?

Participating Research Institutions

Civilian

- Boston University
- Harvard University
- Loyalist College, Canada
- University of South Hampton, UK
- York University, Canada

Participating Research Institutions

Military

- Army Research Labs (ARL)
- Cranfield University
- Defense Research and Development , Canada
- Defense Academy of the United Kingdom
- George Mason University
- Johns Hopkins University
- Military Polytechnic Academy, Army of Chile
- National Defense University
- Naval Post Graduate School
- Portuguese Military Academy
- Singapore Armed Forces Centre For Military Experimentation
- US Army War College
- US Military Academy

Next Steps

- Continuing feedback loop – bringing new research to classroom
- Teaching the new skill of how to optimize the organizational approach for the task and situation
- Individualized training

ELICIT v2.5

For More Information

The CCRP makes ELICIT available free of charge to all members of the ELICIT Community of Interest (COI)

Information about joining the COI is available at
<http://www.dodccrp.org/html4/elicit.html>

For more information about the CCRP or ELICIT
contact Dr. David.Alberts [at] osd.mil or
Mary [at] azigo.com

Q&A